



Intel® 845G Chipset Family Dynamic Video Memory Technology (DVMT)

White Paper

May 2003

Document Number: 253148-002



INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL® PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER, AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. Intel products are not intended for use in medical, life saving, or life sustaining applications.

Intel may make changes to specifications and product descriptions at any time, without notice.

Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

The Intel® 845G chipset family may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Intel and the Intel logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

*Other names and brands may be claimed as the property of others.

Copyright © 2002 – 2003, Intel Corporation



Contents

1	Introduction.....	5
1.1	Overview.....	5
1.2	Dynamic Video Memory Technology.....	5
1.3	Legacy VGA/SVGA Memory.....	5
2	Intel® DVMT 2.0 Graphics Memory Footprint.....	7
2.1	Factors in Footprint Variance.....	7
2.2	Base Allocations.....	7
2.3	Maximum Allocations.....	7
2.4	Memory Allocation Examples.....	8
2.4.1	Memory Requirements Formulas.....	8
3	Reported Video Memory.....	9
3.1	Video BIOS POST message.....	9
3.2	Microsoft Windows NT* 4.0 / Windows* 2000 / XP Display Properties “Adapter” Tab.....	9
3.3	Microsoft DirectX* Diagnostic Tool.....	9
3.4	Video Memory Checks in Microsoft DirectX* Games.....	10

Tables

Table 1. Acronyms.....	8
Table 2. Memory Usage.....	8

Revision History

Revision Number	Description	Revision Date
-001	Initial Release.	June 2002
-002	Document reformatted; minor text changes throughout	May 2003

1 Introduction

1.1 Overview

This document describes the Memory Allocation and Usage Model for the Intel® 845G chipset family with the PV 11.x Display Drivers. This document assumes that the reader already has an understanding of the feature set of the 845G chipset family.

Note: This document is accurate to current feature sets, and does not mention future or proposed new features or functionality.

1.2 Dynamic Video Memory Technology

The method of memory allocation where the operating system, application and graphics memory come from a unified system memory pool known as Unified Memory Architecture (UMA).

Dynamic Video Memory Technology (DVMT) is an enhancement of the UMA concept, wherein the optimum amount of memory is allocated for balanced graphics and system performance, through Direct AGP (known as Non-Local Video Memory, or NLVM), and a highly efficient memory utilization scheme. DVMT ensures the most efficient use of available memory – regardless of frame buffer or main memory sizing – for maximum 2D/3D graphics performance. DVMT dynamically responds to system requirements, and application demands, by allocating the proper amount of display, texturing and buffer memory after the operating system has booted. For example, a 3D application when launched may require more vertex buffer memory to enhance the complexity of objects, or more texture memory to enhance the richness of the 3D environment. The operating system views the integrated graphics driver as an application, which uses Direct AGP to request allocation of additional memory for 3D applications, and returns the memory to the operating system when no longer required.

1.3 Legacy VGA/SVGA Memory

DVMT is a unique architecture that uses a variable amount of system memory for graphics and system operation, adjusting the balance dependent upon demand. The 845G chipset family offers a selection of three different pre-allocated memory sizes: 512 KB, 1 MB or 8 MB. This amount is chosen via the system BIOS as a setup option. This pre-allocated memory selection is supplied for legacy VGA and SVGA graphics support and compatibility.

Upon boot, the system BIOS will pre-allocate the amount of memory selected (512 KB, 1 MB or 8 MB). This memory is taken from the main system memory and will be dedicated for VGA/SVGA graphics. Examples of when VGA graphics memory is needed include usage for high-resolution games and applications run from Microsoft MS-DOS* or a legacy operating system, where there is no 845G chipset family graphics driver loaded. Once the operating system boots, this pre-allocated memory is not seen and is not visible by the operating system. The 845G chipset family's integrated graphics device will then treat this memory as a true, dedicated frame



buffer. If an operating system is booted with an 845G chipset family graphics driver loaded, the pre-allocated memory will then be claimed for use by the graphics driver. The operating system is incapable of reclaiming pre-allocated memory and may never use it. It is available to graphics memory related application usage only.

2 Intel® DVM T 2.0 Graphics Memory Footprint

The driver determines the amount of pre-allocated memory needed and will make additional non-local video memory requests to achieve the total amount needed for the display and application graphics memory operational footprint.

2.1 Factors in Footprint Variance

The 845G chipset family UMA memory footprint varies, and is determined using several factors. The key factors are system resources and system activity. Unlike the Intel® 81x chipset family, the 845G chipset family memory footprint is not static. Memory footprint will vary in size as system requirements and demands vary. For example, when running a DVD in a window on the desktop, memory is needed for the DVD and the background desktop. However, when running a DVD full screen, the desktop frame buffer may be discarded or paged back to disk. This is the most efficient use of memory.

DVD playback is just one of many activities that could effect memory allocation. The following section will describe some of the factors that aid in the request for page locked memory. The operating system does not always grant the graphics driver's memory request.

2.2 Base Allocations

Part of the graphics memory allocation is dependent upon system activity. These are base allocations that the driver requests at the time it loads. For the 845G chipset family, the driver allocates 204 KB for the command ring buffer and cursor/context buffer memory on all operating systems.

Once loaded, the operating system and graphics driver allocates the buffers that the driver needs for performing graphics operations. The total graphics footprint allocates memory for commands, the frame buffer (resolution), the Z-buffer, GDI data, and off-screen memory.

2.3 Maximum Allocations

When graphics memory is being allocated from system memory, the total DVM T graphics footprint in system memory is capped to an upper-limit, ensuring the best usability and performance of the operating systems, applications and graphics. The 845G chipset family platform supports a minimum of 128 MB of system memory.

With **128 MB** of system memory, the 845G chipset family graphics driver will limit the graphics memory footprint to **32 MB**.

On driver **versions up to but not including PV11.1**, for systems with **greater than or equal to 128 MB** of system memory, the 845G chipset family graphics driver will limit the graphics memory footprint to **48 MB**.

Beginning with driver version **PV11.1**, for systems with greater than **128 MB** of system memory, the video memory limit increased to **64 MB**. This was done to improve graphics performance.

2.4 Memory Allocation Examples

In the following scenarios formulas will be given to help calculate what the driver may request for graphics memory.

Note: The driver utilizes pre-allocated memory before it makes request to the operating system and the memory calculated below is in addition to the 204 KB that is allocated once the driver is loaded

Table 1. Acronyms

Abbreviation	Definition
PDTH	Primary Desktop Height
PDTW	Primary Desktop Width
PDTCD	Primary Desktop Color Depth (Bytes: 8 bit = 1 Byte, 16 bit = 2 Bytes, 32 bit = 4 Bytes)
DVDH	DVD Height
DVDW	DVD Width
DVDCD	DVD Color Depth (Bytes)
GH	Game Height
GW	Game Width
GCD	Game Color Depth (Bytes)

2.4.1 Memory Requirements Formulas

Table 2. Memory Usage

Scenario	Formula	Comments
Idle Desktop	$(PDTH \times PDTW \times PDTCD)$ 800 x 600 x 2 = 960000 Bytes, 937.5 Kb	Desk only memory usage. 800x600 @16bit color = ~ 1 Mb
DVD in Window	$(PDTH \times PDTW \times PDTCD) + (DVDH \times DVDW \times DVDCD)$	This takes into account the desktop and DVD that is playing.
Full Screen DVD	$(DVDH \times DVDW \times DVDCD)$	We can discard the desktop because it cannot be seen.
Game in Window	$(PDTH \times PDTW \times PDTCD) + 4 \times (GH \times GW \times GCD)$	This takes into account the desktop and the game that is being played. Note: The game could be triple buffered and utilize the Z/W buffer. That is why there is a 4X multiplier.
Full Screen Game	$4 \times (GH \times GW \times GCD)$	We can discard the desktop because it cannot be seen.

3 **Reported Video Memory**

In systems using an 845G chipset family with PV 11.x Display Drivers, end-users will be presented with various messages/displays concerning “video memory size”. This section describes the messages displayed by the operating system, video BIOS and driver.

3.1 **Video BIOS POST message**

Users may first be presented with “video memory size” messaging in the video BIOS “splash” or “boot” message. This message displays the amount of main system memory that will be used solely for video BIOS purposes. DOS, for example, will use this memory for display only. Video BIOS will use 512 KB, 1 MB or 8 MB of memory, based on system BIOS settings. From the operating system’s perspective, this memory is logically removed from the system so that it is invisible. For example, a system which has 128 MB of main system memory installed with an 8-MB UMA system BIOS setting, will report 120 MB of **total** system memory. This is the pre-allocated memory already mentioned in section 1.3

3.2 **Microsoft Windows NT* 4.0 / Windows* 2000 / XP Display Properties “Adapter” Tab**

Microsoft Windows NT* 4.0, Windows* 2000 and Windows* XP operating systems contain an “Adapter” tab that is located in the “Display Properties” / “Settings” / “Advanced” dialog in Windows 2000 and Windows XP and is located in the “Display Properties” / “Settings” / “Adapter” dialog in Windows NT 4.0. This tab displays the maximum amount of frame buffer memory for the graphics device.

3.3 **Microsoft DirectX* Diagnostic Tool**

The Microsoft DirectX* Diagnostic Tool is included in most versions of Windows operating systems. On the “Display” tab of this utility, there is an item labeled: “Approx. Total Memory.” The amount of video memory listed on this tab varies between Windows versions, DirectX versions, graphics driver versions, and the current video mode. In Windows 98 configurations, the amount of memory reported would typically be 0.5 MB to 5 MB higher, depending on screen resolution and active applications.

For Windows 2000 and Windows XP only, the video memory size reported in the DirectX Diagnostic Tool is always 32 MB. This graphics driver change is to support applications and games that use the same method as the DirectX Diagnostic Tool to determine the amount of video memory. Microsoft Plus! for Windows XP is one such application.

The DirectX Diagnostic Tool’s reported memory will always be 32 MB in all possible configurations.



3.4 Video Memory Checks in Microsoft DirectX* Games

Some games that use DirectX for graphics display will check for available video memory in order to confirm that the system meets the minimum requirements to run the game. There are a number of different methods used to determine available video memory:

- Some games use a DirectX call to get the amount of local video memory. Games that use this method to check for 8 MB or more of local video memory in Windows 98 may fail to install or run with DVMT.
- Some games may request that only local video memory be allocated for performance reasons. With DVMT, only non-local video memory may be available for the game, resulting in the game failing to run.

In most cases, a patch for the game can correct either of these issues.